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COMMISSIONING AND OPERATING
INSTRUCTIONS OF ONE PINT JUST MIXER

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Commissioning and Operating Instructions of One Pint (US) Mixer

P.J. Barry and J. Levers

MRL Technical Note
MRL-TN-634

Abstract

A one pint (US) vertical bladed planetary action mixer was installed in Production Development Area No. 2 of MRL Explosives Ordnance Division, Salisbury. This report describes the rationale for purchasing the mixer, along with a description of the equipment installed, together with operating instructions.

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Commissioning and Operating Instructions of One Pint (US) Mixer

1. Introduction

The development of small scale cast composite propellant formulations in Ordnance Systems Division of Weapons Systems Research Laboratories, Salisbury, prior to 1986 was carried out using vertical anchor blade type mixers. A serious flaw in the performance of this type of mixer limited the range of formulations which could be mixed uniformly to those of relatively low solids loading. Staff wished to increase the performance of propellant formulations being developed. These formulations required a higher solids loading than formulations hitherto designed.

This requirement was catered for in large scale mixing by purchasing a 30 gallon (US) Baker Perkins vertical bladed planetary action mixer. However, small quantity cast composite propellants or polymer bonded explosives could still only be processed using anchor blade mixers of various capacities.

A decision to upgrade the composite propellant facility resulted in the installation of three vertical bladed planetary action mixers of increasing capacity, so that

- each formulation would receive uniform mixing due to there being no part of the mix which is idle beneath a blade. This uniformity of mixing is a consequence of the planetary action of one mixer blade about the other, relative to a stationary bowl.
- scale up of mix size would present no processing problem.
- each mix would experience similar shear rates due to each mixer having the same design parameters.

Over several years, a five gallon (US), one gallon (US) and a one pint (US) mixer have been obtained and installed. The capacity of these mixers is the volume at normal working level – to the top shoulder of the blades when at rest.

While the five gallon and one pint mixers were purchased second hand from Baker Perkins, the design of the one gallon (US) mixer was determined by staff of Engineering Support Group. This involved interpolation of design parameters of the other three mixers, together with fabrication or purchase of particular parts.

In several cases, the equipment used was specified by the maker in non-SI units. These non-SI units have been retained throughout this report.

2. Plant Siting

For a site plan of the relevant buildings and bays, refer to the drawing in Appendix 2.

2.1 Control Room

The Control Room for the one pint (US) mixer is located in Bay 2 of Building 123, Contractors' Area. This bay has the dimensions 5.87 m \times 5.72 m, and is the closest available bay to the mixer bay. Closed circuit television is provided to monitor the activities in the process bay.

2.2 Services Bay, Building 273

The services bay, which has the dimensions 2.3 m \times 2.3 m, is within the same overall building as the process bay. It contains vacuum pump, TV camera, emergency drenching power supply and thermocirculator, as well as drenching system controls. Service facilities such as compressed nitrogen and cooling water are located outside the plant bay, but within the traverse of the building.

2.3 Process Bay, Building 273

This bay, which has the dimensions 2.3 m \times 2.3 m, contains the one pint (US) mixer, and is located as close as possible to the existing vacuum and propellant casting facility in bay 1 of building 123.

2.4 Traversing

The mixer bay has an explosives licence for 1 kg of Hazard Division 1.1 or 1.3 material. The traditional double sloped earth mound had the disadvantages of being costly and requiring the process bay/s of the building protected to be further away from adjacent facilities than was desirable (refer to map at Appendix 2). The three main pipes – 8 ft diameter \times 16 ft long reinforced concrete stormwater pipes set on end, were initially considered to be sufficient traversing. A re-assessment of the level of public risk resulted in the provision of three smaller reinforced concrete pipes on

the north-east side of the first pipe group. The traverses prevent the projection of any primary fragment at an angle of less than 45° to 50°.

3. Plant Description

3.1 Mixer

One pint (US) capacity, vertical bladed, planetary action mixer, Baker Perkins model type 2 PX (see Fig. 1).

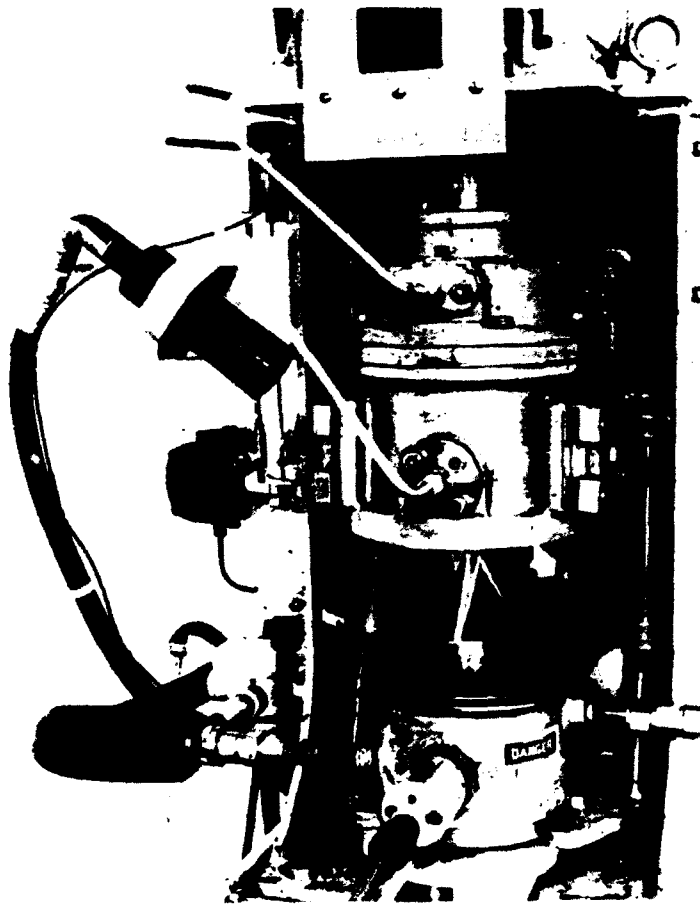


Figure 1: One Pint Mixer. Lower Front: Orange thermocouple connection. Lower Left: Heating/Cooling connection. Upper Left: UV detector pointing through viewing port. Vacuum interceptor, Glass, behind UV detector. Centre: Two vacuum lines from head of mixer.

3.2 Drive System

110 volt DC electric motor, "Reliance 718370 WC" with "Rapier" solid state speed control and "Boston" right angle gear reducer.

3.3 Blade Speed and Measurement

0 to 100 r/min, with 2:1 planetary reduction gearing between the blades. Speed measurement is taken via a fibre optics transducer and encoder wheel to a signal transmitter and converted to a 4 to 20 mA signal to the control panel.

3.4 Temperature Control

The emergency cooling is water based, and is only used when the time taken to cool the mix in air would be excessive, such as when a suspected exothermic reaction occurs.

Refrigerated water is piped from a modified "Temprite" water cooler, and controlled by an M.E. Mack solenoid valve which is operated from the mixer control panel. Cooling is by means of a heat exchanger immersed in the heating oil reservoir.

Heating is by means of "Shell Ondina 68" paraffin oil, which is circulated from a Haake Thermocirculator Model "G", Type 000-3959 (see Fig. 2).

The remote outlet set point signal for the "Haake" thermocirculator is taken via a 4 to 20 mA current loop either from the computer keyboard, via the programmable logic controller, or from manual operation of a potentiometer on the control panel. This signal inputs to the "Haake" Temperature Controller.

There are two platinum resistance temperature devices (RTDs) in the fluid reservoir of the "Haake" unit. One of these devices provides a control signal to the "Haake" Temperature Controller as actual value. The other device observes the "Haake" reservoir temperature, which it transmits as a 4 to 20 mA signal to the control panel via a signal transmitter. The control panel operator periodically checks this reading.

3.5 Temperature Measurement

This is achieved by a platinum resistance temperature device (RTD) accessing the mixing can (see Fig. 1). A 4 to 20 mA signal is sent to the control panel via a signal transmitter. Ambient temperature and humidity are sensed and transmitted in a similar way.



Figure 2: North West End of Services Bay. Under Bench:: Electronics Rack and Rapier Control Key. On Bench:: Haake Thermocirculator.

3.6 Raise/Lower System for Mixer Bowl

The hydraulic raise/lower facility is based on two nitrogen capped oil reservoirs, interlinked via a system of pilot operated solenoid valves (Abex-Mead Type SA3-0553, 5 port, two way), which control nitrogen distribution above the oil. The oil operates a hydraulic (double action) cylinder, the body of which is mounted on the mixer support frame. The piston rod extends to the rear of the mixer can lifting cradle.

This system also contains two solenoid operated directional control valves, "Lucifer" 481865 and two "Flutek" flow control valves with manual micrometer adjustment to set the raise or lower speed rate of the mixer can.

This system reduces the lengthy response time needed to reverse hydraulic action, which would occur if the control action was performed at the control panel, due to the low pressure and long lines involved.

In the emergency mode, such as following detection of a fire, the response time for the bowl to start its downward movement after command is less than 0.5 s.

The nitrogen feed to cap the oil reservoirs comes from either of two "G" size cylinders, each of which is fitted with a CIG regulator (Comweld D 89) (see Fig. 3) which is set to deliver the nitrogen at approximately 800 kPa pressure.



Figure 3: Nitrogen bottles between earth filled concrete pipe traverse sections. Solenoid operated drench valve in pipeline at right.

3.7 Vacuum

The vacuum pump used is a "General" (UK) rotary vane pump, type GDV 25, having a displacement of 22.75 cubic metres per hour, and working down to ≈ 1 torr pressure (see Fig. 4).

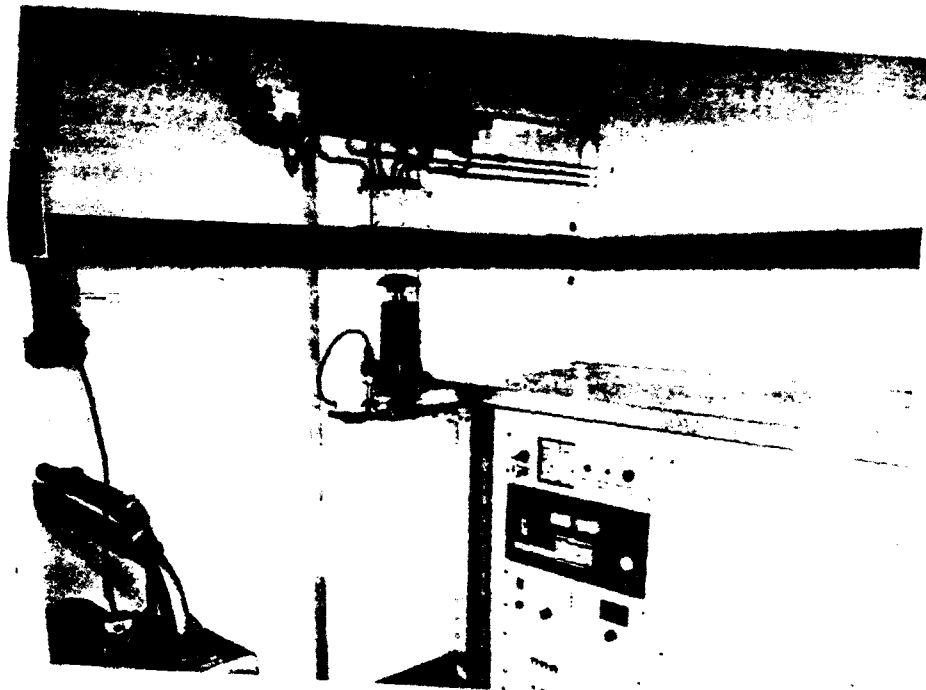


Figure 4: South End of Services Bay. Far Left: Vacuum Pump and Switch. Centre and Right: Electrical switches for Drench and Emergency Power Supply.

The distribution system involves.

- (i) 2 No. "Vacutec" Absolute Pressure Transducers, Model CFL 1000.
- (ii) 2 No. "Saunders" Vacuum Isolation Valves, Model ES 61.
- (iii) 1 No. "Square D Company" Vacuum Differential Valve, Type BMW 2, Form F, 0.5 to 29" Hg (1.7 to 98 kPa), Differential 2 to 8" Hg (7 to 27 kPa).

Signal transmitters send 4 to 20 mA signals of can pressure and ballast pressure to the control panel. This is in addition to the pressure gauges on each vacuum line above the control panel.

3.8 Blade Load/Torque Measurement

These relative values are calculated from the feedback signal generated by the DC speed control, as a function of the drive motor power consumption. A signal transmitter converts a 0 to 10 Volt output to a 4 to 20 mA signal to the control panel.

3.9 Flame Detection and Drench System

The deluge system is fed from the 4" water main serving the DSTO area. In the mixer bay, the system feeds four "Wormald" high velocity HV 26 water spray nozzles, each of which can deliver up to 26 gal/min of water at 760 kPa to this bay.

Automatic flame detection is by means of two "Honeywell" UV sensors, No. C7305A, through a "Honeywell" flame detector relay, No. R4343D, one of which is mounted adjacent to one of the two inspection windows on the mixer headworks, while the other overlooks the mixer bay. Each UV sensor is interlocked to an amplifier which, when triggered, energises a "Danfos" bronze bodied 2 inch (50 mm) pilot solenoid operated (240 V, 50 Hz) balanced piston valve. This valve allows mains pressure water to the four "Wormald" HV 26 drench nozzles which are located in the top corners of the mixer bay.

In the event of a fire being observed, the mixer operator can activate the deluge system using the manual deluge switch on the control panel.

There are also two "Penn" P 48A pressure switches in this system. The high pressure switch is used to monitor the mains water pressure, and is linked through the PC to a low water pressure alarm.

It is safe operating practice not to continue mixing should the mains water pressure fall below 300 kPa, which is the set point of the low water pressure alarm. This ensures that adequate water flow is always available for total spray coverage of the mixer bay in the event of an emergency.

The low pressure switch prevents the de-energising, after operation, of the "Danfos" valve until a very low water pressure/flow is achieved by manual closure of the mains isolation valve. This action prevents water hammer induced by premature closure of the "Danfos" valve under high water flow conditions, during shut down of the drench system after actuation. The 4" external mains are some 45 years old and susceptible to breakage due to water hammer.

3.10 Warning Lights

The warning lights are "Commander", one amber and one red, each with rotating reflector. These are activated either from the control panel in manual operation or, in automatic operation, by computer response to the questions which are answered by the operator while keying in the parameters for the next mixing cycle.

3.11 Closed Circuit TV

The closed circuit TV camera is a monochrome "Canon" FA 73, fitted with a "Canon" zoom lens, Model No. J6Y12R(DC), 12.5 mm to 75 mm zoom.

An overview of the process bay containing the mixer is provided by the TV camera mounted high in the north-east corner of the services bay, viewing through a polycarbonate dome window into the process bay. The zoom facility on the camera enables close watch of the mixer during operation. The camera also enables the control panel operator to verify the absence of personnel in the mixer bay during mixing (see Fig. 5).

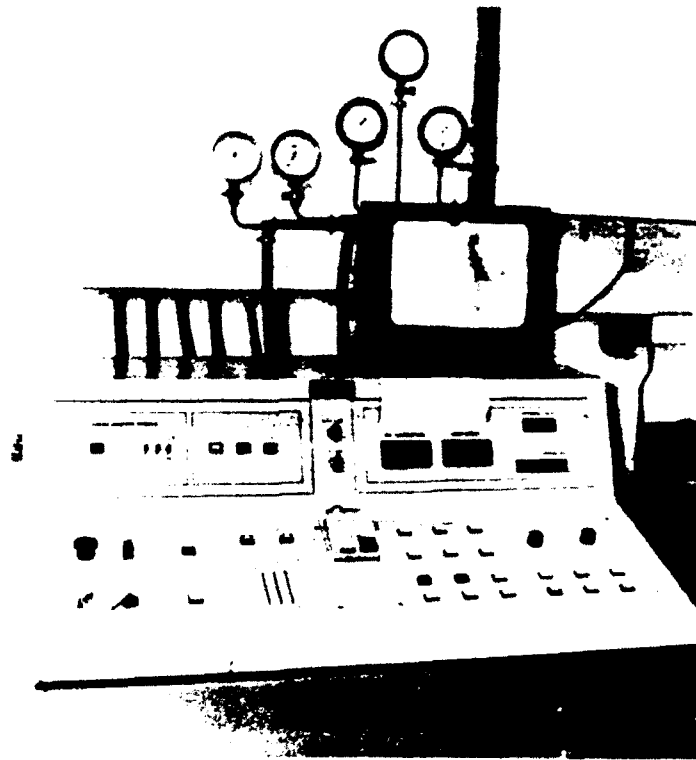


Figure 5: Control panel, with TV screen showing mixer bay.

3.12 Control System

Programmable Logic Controller (PLC). Three units are used:

- (i) Toshiba EX40H PLC, for alarm conditions and mixer bay functions.
- (ii) Struthers Dunn Programmable Controller, for sequencing.
- (iii) IBM Compatible Laser Turbo XT/2, with Compal Monitor, for communications.

3.13 Auto/Manual Control

The mixer may be controlled either manually through the control panel or automatically through the Laser Turbo XT/2 Computer. Selection of mode of operation is by a key switch mounted on the Control Panel (see Fig. 5).

3.14 Plan Shared with One Gallon (US) Mixer

The control panel, in either automatic or manual mode, together with the closed circuit TV can be set to operate and monitor either the one pint (US) or the one gallon (US) mixer. The one gallon (US) mixer is located in Bay 5 of Building 123.

3.15 Electric Power Supply

The electric power supply is three phase 415 Volt AC and 110 and 24 Volt DC, with 24 Volt DC (battery backup).

4. Description of Commissioning Activities

4.1 Temperature Control of Normal Upper Temperature

A series of tests was run using water to determine the ability of the heating and cooling system to deliver a pre-determined temperature in the range 10°C to 70°C. The temperature controls were adjusted several times in order to minimise response time and overshoot of set point, and to ensure that local set points were mimicked remotely at the control panel.

4.2 Inert and Live Mixes

A series of comparative assessment mixes were carried out on a standard formulation in order to compare the characteristics of the individual types of mixers. These assessment mixes confirmed that planetary style mixers have a higher mixing efficiency than do anchor blade type mixers which, by their design, leave an unmixed "dry" spot in the bowl under the centre of the blade, especially with high viscosity mixes. Physical and chemical examinations of the propellants now indicate better homogeneity and less physical attrition of the solids dispersed than was the case with mixes made using the anchor blade type mixers.

4.3 Operating Instructions

Concurrently with the mixing program described above, operating instructions were developed for both the manual and automatic modes of each stage of the preparation of a mix. Initial documentation was prepared and verified using "Dry Running" of the mixer. Verification proceeded further during the preparation of inert mixes by Propellants Group. Revisions of the draft instructions were required as unforeseen problems were encountered and solutions to these problems were developed and recorded. The computer programming and instruction preparation for automatic control of each cycle of operations in the course of a given mix formulation were then developed and debugged. Finally, these instructions were submitted to the Head of Propellants and the Head of Engineering Support Groups for approval and issue. A copy of these instructions is provided in the Appendix.

4.4 Testing of Safety Features

Several trials of emergency situations were conducted in order to verify that the equipment system concerned gave both the time response and required effects. These tests involved the dry and live testing of the Drenching System, both from the Control Panel and by shining a low wattage UV source light at each individual UV sensor in turn from a position adjacent to the mixer can. The tests also involved observing the descent of the Mixer Can under these conditions. The nitrogen pressure interlock into the drench system was also tested. (Note: This interlock has since been removed. Refer to Section 3.9 for current system).

5. Conclusions

The one pint (US) mixer was found to function satisfactorily over the required range of temperatures, mixer speeds and vacuum conditions. Further, this mixer delivered reproducible results in successive mixes having the same formulation and mixing procedure.

This mixer is thus adequate for the purpose of handling a wide range of mix formulas and process conditions, and further to provide adequate material for the samples required to verify performance parameters in the initial stages of propellant formulation and processing development.

6. Acknowledgements

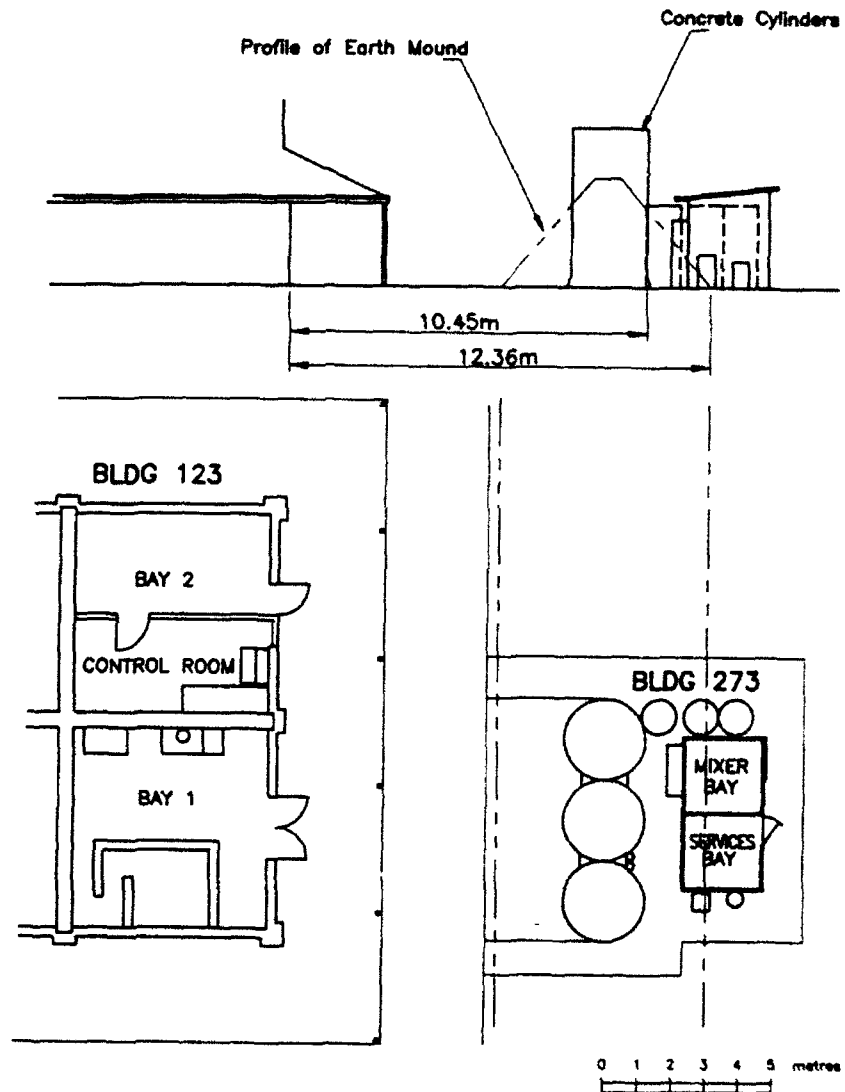
The specification and development of the equipment to its present reliable state of operation has involved many of the personnel of Engineering Support Group, Explosives Ordnance Division, Salisbury.

Appendix 1

The drawings and details of equipment circuits for the one pint mixer are contained in the Drawing Series IP-001 to 004, which covers Layout and Overview, Electrical Circuit Diagrams, Chassis and Rack Detail, and Electrical Circuit and Wiring Detail. These drawings are kept in the Engineering Support Drawing Office, Explosives Ordnance Division, Salisbury.

Appendix 2

Drawing, showing location of One Pint Mixer, Building 273, relative to the eastern end of Building 123.



The location of the Mixer Building which is made possible by the use of vertical concrete cylinders in lieu of the traditional earth mound/traverse, and is shown with the outline of the intruding influence of the mound.

Appendix 3

OI 5.9
Issue 2
Cover Page

Weapons Systems Research Laboratory
Ordnance Systems Division
Operating Instruction No. 5.9

One Pint Vertical Mixing and Casting Facility

This instruction specifies the procedures to be used in operations performed in the One Pint mixer and associated casting equipment in the complex in PDA2.

Formulation and process parameter details are not included in this instruction. These are specific to the mix being performed and are detailed in Propellant/Explosive Processing Sheets.

Prepared by _____

Authorised by:	_____	_____
	Head, Engineering Support	Head, Propellants
	/ /	/ /

Distribution:

G9204/3/6
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Safety Section

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Propellant Development Area No. 2

Operating Instruction No. 5.9

One Pint Baker Perkins Vertical Mixing Facility

1. Introduction

This instruction specifies the operations to be followed in all phases of processing operations in the Baker Perkins One Pint mixer and use of the associated casting equipment from preparation to cleaning of contaminated equipment.

2. Location

Industrial Area

- (a) Mixing - Building 273
- (b) Casting - Building 123, Bay 1
- (c) Control Cell - Building 123, Bay 2
- (d) Plant Room - Building 273

3. Personnel

- 3.1 Only personnel who have training and experience in explosives handling and have been instructed in the relevant precautions shall be permitted to work in explosives operations.
- 3.2 The personnel who carry out the following operations shall be persons assessed by H Eng or his delegate as competent in operation of the equipment and understanding of the safety requirements of the processes. These persons are listed in Annex A. The number of personnel in the vicinity of Buildings 123, Bay 1 and 273 shall not exceed 4 during explosives operations.

4. Special Precautions

- 4.1 The requirements of Section 2 of DSTO Safety Regulations shall apply.
- 4.2 Prior to explosives mixing operations, place a warning sign beside each of the two paths leading to the Plant Room and Mixer Bay.

- 4.3 When the mixer is loaded with oxidant or other explosives and the blades are turning, entry into Building 273 is forbidden.
- 4.4 Weighing and handling of ingredients is to be performed using respiratory protective equipment.
- 4.5 No person shall enter Building 273 without permission of the Operator-in-Charge of the Control Cell (Building 123, Bay 2).
- 4.6 No mix is to be prepared without a PROPELLANT/EXPLOSIVES PROCESSING SHEET issued by Head of Propellants Group or his delegate.
- 4.7 A Mix Log must be completed on the PROPELLANT/EXPLOSIVE PROCESSING SHEET for all mixes. All sequences must be recorded along with any unusual events, no matter how insignificant they might seem to be.
- 4.8. All weighing details shall be entered on an Ingredients/Weighing Check Sheet and certified as required by the O-I-C, PDA2.
- 4.9. The mixer shall not be used if the clearances between the mixer blades and the mixer do NOT conform to those approved by the Head of Engineering Support Group.
- 4.10 The Operator-in-Charge of the Control Cell shall ensure that all personnel within the area of the warning signs are in the Control Cell when explosives mixing operations are being carried out.
- 4.11 The Control Cell doors should be kept closed during explosives mixing operations.
- 4.12 The Operator-in-Charge of the Control Cell shall call a warning through the intercom before raising or lowering the mixer can.
- 4.13 In the event of the Deluge System being activated, automatically or manually, all personnel in the Control Cell shall remain in the Cell until advised by the Officer-in-Charge that it is safe to leave.
- 4.14 All spilt ingredients shall be immediately swept up and placed in the appropriate waste bin.

- 4.15 Phosphor-bronze or Velostat spatulas shall be used for the "scrape down" operations specified in the Mixing Procedure.
- 4.16 When explosives are "on site", the amber beacon lights shall be operating.
- 4.17 When explosives are being mixed in the mixer can, the red and amber beacon lights shall be operating.

5. Preparation of Equipment

- 5.1 Collect Control Cell (Bldg 123, Bay 2) key, mixer isolator key, Bldg 273, mains and water bypass keys for the Plant Room, Bldg 273, and the two system and operation keys for the Control Panel, Bldg 123, Bay 2.
- 5.2 Unlock Bldg 123, Bay 2 and switch on bay lights situated outside the bay door. At the top right of the control panel, ensure that the orange control panel isolating switch is on. On the control panel, ensure that the two mixer can position push buttons (raise and lower) are in the UP position.
- 5.3 Check that the intercom and phone are working.
- 5.4 Insert the two system selection and operation keys and select manual mode by turning key clockwise. System 1 refers to the One Pint Mixer, Bldg 273. System 2 refers to the One Gallon Mixer, Bay 5, Bldg 123.
- 5.5 Ensure deluge switch is in the off position, i.e. toggle switch down and cover on.
- 5.6 Press the Equipment Power button. Ensure that the
 - Camera control monitor power light shows Orange,
 - PLC status low volts and CPU run lights show Green,
 - Mixer can operations "Lower" button light is on,
 - Deluge primed light is flashing, indicating water pressure at the mixer is low or off.
- 5.7 Turn TV monitor power point and power switch below monitor screen on.
- 5.8 Ensure that all other Control Panel lights are off.
- 5.9 Ensure Emergency Stop button is in the Up position.

- 5.10 Press the FUNCTION VERIFY and CAN VAC buttons. While you hold BOTH buttons down, the following lights will be ON: Raise, Lower, Run, Vacuum Pump, Deluge Primed. The vacuum ballast tank will vent provided it has no signal to prevent this. When the ballast tank has vented fully, as shown by pressing key 7 on the keyboard, ensure that the CAN VAC button is released.
- 5.11 Move to Mixing Area, Bldg 273. Behind the Mixing Bay, ensure that the two pairs of circuit breakers in the right hand cupboard are On, i.e. Up.
- 5.12 Select the nitrogen cylinder to be used. Ensure that the Black/Blue regulating knob on this cylinder is free to rotate, and the small black headed valve on the line from this cylinder to the manifold is open. Ensure that the other black headed valve is closed. Ensure that the three black lever valves leading from the manifold are on, i.e. levers are vertical. Open the main valve of the cylinder to be used. Adjust the system pressure to 800 kPa by turning the regulating knob clockwise.
- 5.13 If drench system test is to be performed:
- 5.13 A: Perform the drench test --
1. LIVE Drench Test.
 - Collect the hoses from storage as directed by the O-I-C, PDA2.
 - In the Mixer Bay, remove the caps on the drench nozzles. Place the end of a hose on the drench nozzle and repeat for the other nozzle.
 - In the paddock recess to the south of the Building, open the mains water valve.
 - In the Plant Room, ensure that the deluge system key switch is off.
 - As directed by the O-I-C, PDA2, activate the drench system by EITHER using an ultra-violet light source adjacent to the mixer. OR return to the Control Panel. Raise the cover on the deluge toggle switch. Move the toggle switch Up and Down once. The flame light on the Control Panel will show Red.
 - Move to the Mixer Bay. Check that the system is discharging through the hoses.

- In the paddock recess south of the building, close the mains water valve.
- Move to the Plant Bay. On the top left panel, press the Blue deluge reset button. The valve on your left will make a loud noise.
- In the Mixer Bay, ensure that water has stopped running through the hoses. Disconnect the hoses and mop up all water in the bay, particularly on the headworks of the mixer.

2. SIMULATED Drench Test

- In the paddock south of the building, check that the mains water valve is closed.
- In the Plant Room, ensure that the deluge system key switch is off, BUT that the water bypass key is On.
- As directed by the O-I-C, PDA2, activate the drench system by EITHER using an ultra-violet light source adjacent to the mixer, OR return to the Control Panel. The deluge primed light should be on continuously. Raise the cover on the deluge toggle switch. Move the toggle switch Up and Down once. The flame light on the Control Panel will show Red.
- Move to the Plant Bay. On the top left panel, press the Blue deluge reset button. The valve on your left will make a loud noise. Turn the water bypass key off.

5.13 B: Purge the Drench Lines of Air --

- Check that the red valve on the small red bypass line above the branch tee to the chiller is closed.
- In the Mixer Bay, ensure that the drench nozzle caps are On.
- In the paddock south of the building, open the mains water lever valve.
- Return to the Mixer Bay and check that there are no leaks past the drench nozzle caps.
- Outside the Mixer Bay door, on the north face of the building, open the bleed valve.
- Open the red BYPASS valve near the chiller switch.
- Check the bleed valve. When water starts to flow from the drain, return to the bypass valve and turn it off.
- Return to the bleed valve and turn it off.

- 5.14 Close and lock the door of the Control Room. Carry this key with you while working at the mixer. Move to the Plant Bay. Check that all circuit breakers on the switchboard on the east wall are on, i.e. Up. Turn the vacuum pump isolator switch on. Ensure that the deluge system key and the water power bypass key S5 is off, i.e. Up.
- 5.15 On the inverter panel, check that input C/B is on, i.e. Up and Red inverter light is on. Check that output voltage shows 240 Volt and amperage a non-zero value.
- 5.16 On the standby battery charger, ensure power switch and overcharge light are on. Turn the control knob to float voltage and ensure that a value of at least 27.1 Volts appears on the digital display. Return the control knob to its original setting.
- 5.17 On the 50/110 Volt power supply, ensure that the three pairs of circuit breakers are on, i.e. Up, and that their lamps are on.
- 5.18 On the Rapier motor control, ensure that the key switch is turned to the on (I) position.
- 5.19 On the left corner of the electronics rack, ensure all four coloured lights are on
- 5.20 Heating and Cooling:
It is very unlikely that both heating and cooling will be required for a given mix. As each of these tests takes some time, record can temperature as shown on the panel every 5 minutes, until you are satisfied that this service is working correctly. Repeat for cooling if required for the forthcoming mix.
 - (a) For the Haake D8 thermocirculator, ensure both power point switches are on. On the thermocirculator, ensure bottom black switch and front Green power switch are in "I" position, i.e. on. Return to the Control Panel and press heat button. Record the can temperature as above.
 - (b) On the outside south wall of the Plant Room, open the red water supply valve to the chiller not more than one turn. After a short delay, check that water is flowing on to the ground near the isolating valve from the outlet of the overflow line, which is situated beneath the main water supply line. Turn the electric switch by the chiller on. Return to the Control Panel and press cool button. Record the can temperature as above.

- 5.21 By the Door, check that the four light switches operate correctly.

Top Left - Mixer Bay.
Top Right - Outside under eaves.
Bottom Left - Spare.
Bottom Right - Plant Room

- 5.22 Above the door, ensure that the TV camera power point is on, and toggle switch is to the right, i.e. on.
- 5.23 Return to the Mixer Bay. Place Lutin on sides and bottom of mixer can for a blade clearance test. Keep the mixer lid off. This test is performed weekly, after each maintenance or as directed by the Foreman.
- 5.24 Ensure that the can is in position and the Teflon spacer is in position below the mixer.
- 5.25 Inject one shot of special grease in each upper housing nipple for every 3 hours mixing. Grease "O-rings" and blow off cover rubber. Check that the main sealing ring gaskets are in place around the outer edge of the top flange of the mixer can.
- 5.26 Connect the thermocouple lead and the water outlet and inlet lines.
- 5.27 Return to the Control Room. Focus the TV camera on the mixer blades, and adjust the camera controls as required.
- 5.28 On the Control Panel, ensure that the deluge primed light is on and NOT flashing and that the gas pressure light is on. Adjust the outlet temperature as required to ensure 60 degrees Celsius on the "Contents Temperature PV" display (Key 3).
- 5.29 As you press each mixer or vacuum function switch, it will flash in parallel with the Function Verify switch. Press the Function Verify switch to commence the relevant action.
- 5.30 Press the Blue Mixer Operations Run switch and the Function Verify switch on. Adjust the mixer speed control to give 5 to 10 rev/min. The mixer blades will commence to turn.

- 5.31 Observe by the TV screen that no one is at the mixer can. Press the switch on the intercom while calling a warning through the intercom: "Stand clear, can going up".
- 5.32 Press Raise and Function Verify buttons. On the TV screen, observe the can rising.
- 5.33 When the can is fully up, press Vacuum Pump and Function Verify switches. Observe the right hand pressure gauge on the wall behind the panel, which shows the pressure in the ballast tank or keg. This pressure should reduce to 2 torr over the next few minutes.
- 5.34 Press the Can Vacuum and Function Verify switches. Observe the left hand vacuum gauge.
- 5.35 When vacuum in can reaches a minimum, release can vacuum by pressing Can Vacuum switch again. Reduce the mixer speed to zero and press the Mixer Operations Run switch to stop the mixer. Release the vacuum pump button.
- 5.36 Check the TV screen to ensure that no one is at the mixer can and call through the intercom: "Stand clear, can coming down".
- 5.37 Press the "Lower" switch. Release the Raise switch. Bring the can down by pressing "Function Verify".
- 5.38 In the Mixer Bay, disconnect the water outlet and inlet flexibles to the mixer can.
- 5.39 Uncouple the thermocouple lead.
- 5.40 Remove the mixer can and spacer.
- 5.41 Measure the Lutin on bottom and sides of mixer can to check if clearances are according to specification. Report results to O-I-C, PDA2.
- 5.42 Remove Lutin from mixer can and blades and clean with methylated spirits.
- 5.43 Press Beacon lamp buttons in turn for Amber Flash and Red Flash and check that each beacon light is working, then press each of these buttons to cancel.

- 5.44 Return to the nitrogen bottle and turn the main valve off. Release the regulator valve until it is free. In the paddock, turn the mains water valve off.
- 5.45 In the Plant Room, on the Haake Thermocirculator, turn the front Green power switch off, i.e. Down, and turn the switch on the top unit to the "O" position, i.e. off. Turn the two power point switches off.
- 5.46 On the Centre panel, turn the Rapier motor control key to the off position
- 5.47 On the left panel, ensure the deluge system key switch and water power bypass key switch S5 is off.
- 5.48 Turn off the vacuum pump isolator switch.
- 5.49 Turn off all light switches by the door.
- 5.50 Close the doors of both bays and return to the Control Panel. Turn off TV power and power point. Press Equipment Power button. Turn off and remove system selection and operation keys. Turn the Orange control panel isolating switch off. Close the bay and turn off the lights.
- 5.51 Return all keys to the O-I-C, PDA2's Office (Bldg 170).

6. Mixing Operations (Manual Control) and Preparation for Automatic Control.

- 6.1 Before mixing operations may commence, the Operator-in-Charge shall have available the PROPELLANT/EXPLOSIVE PROCESSING SHEET approved as in 4.5 above. An INGREDIENTS/WEIGHING CHECK SHEET shall also be at hand.
- 6.2 Collect the following Keys from the Supervisor's Office (Bldg 170):
 - Bldg 123, Bay 2: Control Cell,
 - Control Panel - System
 - Operation
 - Bldg 273: Plant Room,
 - Mixer Isolator,
 - Water Bypass and Mains

- 6.3 Unlock Bldg 123, Bay 2 and switch on bay lights at the switch outside the bay door. At the top right of the control panel, ensure that the orange control panel isolating switch is on. On the Control Panel, ensure that the two mixer can position push buttons (raise and lower) are in the UP position.
- 6.4 Check that the intercom and phone are working.
- 6.5 Insert the two system selection and operation keys and select Manual mode by turning key clockwise. System 1 refers to the One Pint Mixer, Bldg 273. System 2 refers to the One Gallon Mixer, Bay 5, Bldg 123.
- 6.6 Ensure deluge switch is in the off position, i.e. toggle switch down and cover on.
- 6.7 Press the Equipment Power and Camera Control Monitor buttons. Ensure that:
 - Camera Control Monitor Power Light shows Orange,
 - PLC Status Low Volts and CPU Run lights show Green,
 - Mixer Can Operations "Lower" Button light is on,
 - Deluge Primed light is flashing, indicating Gas Pressure is low or off.
- 6.8 Turn TV monitor power point and power switch below monitor screen on.
- 6.9 Ensure that all other Control Panel lights are off.
- 6.10 Ensure Emergency Stop button is in the Up position.
- 6.11 Press the FUNCTION VERIFY and CAN VAC buttons. While you hold BOTH buttons down, the following lights will be ON: Raise, lower, Run, Vacuum Pump, Deluge Primed. The vacuum ballast tank will vent provided it has no signal to prevent this. When the ballast tank has vented fully, as shown by pressing key 7 on the keyboard, ensure that the CAN VAC button is released.
- 6.12 Close and lock the door of the Control Room. Carry this key with you while working at the mixer. Place a warning sign beside each of the two paths leading to the Plant Room and Mixer Bay.

- 6.13 Move to Mixing Area, Bldg 273. Behind the Mixing Bay, ensure that the two pairs of circuit breakers in the right hand cupboard are on, i.e. Up.
- 6.14 Select the nitrogen cylinder to be used. Ensure that the Black/Blue regulating knob on this cylinder is free to rotate, and the small black headed valve on the line from this cylinder to the manifold is open. Ensure that the three black lever valves leading from the manifold are on, i.e. levers are vertical. Open the grey main valve of the cylinder to be used. Adjust the system pressure to 800 kPa by turning the regulating knob clockwise.
- 6.15 In the fence recess south of Bldg 273, open main water isolating valve. If cooling will be needed, turn on the cooling water switch on the south outside wall of the Plant Bay. Open the Red water isolating valve leading to the chiller, until water comes from the outlet in the paddock near the fence recess. Close this valve until cooling is needed.
- 6.16 Move to the Plant Bay. Check that all circuit breakers on the switchboard on the east wall are on, i.e. Up. Turn the vacuum pump isolator switch on.
- 6.17 Ensure that deluge system key switch (above mains label) and water power bypass key S5 are off.
- 6.18 Ensure drench nozzle caps in top corners of mixer bay are not leaking.
- 6.19 On the inverter panel, check that Input C/B is on, i.e. Up and Red inverter light is on. Check that output voltage shows 240 Volt and amperage a non-zero value.
- 6.20 On the standby battery charger, ensure power switch and overcharge light are on. Turn the control knob to float voltage. Ensure that a reading of at least 27.1 Volts is displayed. Turn knob back to previous setting.
- 6.21 On the 50/110 Volt power supply, ensure that the three pairs of circuit breakers are on, i.e. Up, and that their lamps are on. On the Rapier motor control, ensure that the key switch is turned to the on (I) position. On the left corner of the electronics rack, ensure all four coloured lights are on.

6.22 & 3 Now in 6.21.

6.24 For the Haake D8 Thermocirculator, ensure both power point switches on the back wall are on. On the Thermocirculator, ensure bottom black switch and front green power switch are in "I" position, i.e. on and the fan is on.

6.25 By the door, check that the four light switches operate correctly.

Top Left - Mixer Bay.

Top Right - Outside under eaves.

Bottom Left - Spare.

Bottom Right - Plant Room.

6.26 Above the door, ensure that the TV camera power point is on, and toggle switch is to the right, i.e. on.

6.27 If working with automatic control, proceed to Section 7

6.28 Take the lidded mixer can to the balance and load the first ingredient as shown on the PROPELLANT/EXPLOSIVE PROCESSING SHEET. Place the lid on the can and return to the Mixer Bay. Place the can in position. Place the Teflon spacer in position below the can. Ensure that the O-ring vacuum sealing gasket is in position around the mixer flange.

6.29 Connect the water outlet and inlet flexibles to the mixer can. Plug in temperature transducer.

6.30 Using the alligator clip provided, secure the earthing lead from the frame to the body of the mixer can. Ensure mixer can lid is off.

6.31 Return to the Control Panel, Bay 2. Ensure that the deluged primed light is on and NOT flashing and that the gas pressure light is on. Adjust the TV camera controls as required. Press the temperature control "Heat" or "Cool" buttons as required. Adjust the outlet temperature knob as required to ensure that the temperature specified on the PROPELLANT/EXPLOSIVES PROCESSING SHEET is shown on the "Contents' Temperature PV" display (Key 3).

Note: When the explosives ingredients are "on site", the amber beacon lights should be activated by pressing the Amber flash button. When explosives ingredients are being mixed, the red beacon lights should be activated by pressing the Red flash button.

- 6.32 As you press each mixer or vacuum function switch, it will flash in parallel with the Function Verify switch. Press the Function Verify switch to commence the relevant action.
- 6.33 Press the Blue Mixer Can Operations RUN switch and the Function Verify switch on. Adjust the mixer speed control knob to give 5 to 10 rev/min. The mixer blades will commence to turn.
- 6.34 Observe by the TV screen that no one is at the mixer can. Press the switch on the intercom while calling a warning through the intercom: "Stand clear, can going up".
- 6.35 Release the lower button if on, press Raise, and press Function Verify. On the TV screen, observe the can rising. The raise light will flash while the can is rising.
- 6.36 When the can is fully up, the raise light will be on steadily. Adjust the mixer speed control to the speed specified on the PROPELLANT/EXPLOSIVES PROCESSING SHEET. If mixing with vacuum is called for, press Vacuum Pump and Function Verify switches. Observe the right hand pressure gauge on the wall behind the panel. This gauge shows the pressure in the ballast tank or keg. This pressure should reduce to 2 torr over the next few minutes.
- 6.37 When 2 torr has been achieved, and the time for mixing without vacuum has elapsed, press the Can Vacuum and Function Verify switches. Observe the left hand vacuum gauge on the wall behind the Control Panel.
- 6.38 During running, the process parameters can be monitored using the keypad. On the top right of the panel, below the value, will be displayed the title of the process parameter being monitored, together with whether the set point value (SP), or the process value (PV), is being displayed.

Normally, the process value of a parameter is displayed, and the set point value of that process parameter is obtained by pressing the right hand arrow on the keyboard. The process value is re-displayed by pressing the left hand arrow on the keyboard.

6.38 (Ctd)

Key Number	Process Parameter
1	Start speed
2	Mix speed
3	Contents' temperature
4	Mix time without vacuum
5	Mix time with vacuum
6	Contents' vacuum
7	Ballast or keg vacuum
8	Mix speed
9	Mixer torque
9, and Down Arrow once	Haake temperature (Thermocirculator)
9, and Down Arrow twice	Bay temperature
9, and Down Arrow thrice	Bay humidity

- 6.39 When the time for mixing as directed has elapsed, reduce the mixer speed to zero and press the Mixer Can Operations RUN switch to stop the mixer. If mixing under vacuum, press the can vacuum button to release the vacuum.
- 6.40 Check the TV screen to ensure that no one is at the mixer can and call through the intercom: "Stand clear, can coming down".
- 6.41 Bring the can down by pressing "Lower", releasing "Raise", and pressing "Function Verify" keys. Close and lock the door of the Control Room. Carry this key with you while working at the mixer.

Note: Weighing and handling of ingredients is to be performed using respiratory protective equipment.

- 6.42 If further ingredient/s are required to be loaded, ensure that each container, scoop and spatula is connected by earthing lead and clamp to the mixer frame. Load mixer can with other ingredient/s as called for in the mixing procedure. Record details on the INGREDIENTS/WEIGHINGS CHECK SHEET.

- 6.43 After connecting the spatula provided to earth, scrape down the blades to ensure that all powder ingredients are in the body of the mixer.
- 6.44 Using a clean dry rag, remove any spilled ingredients from top of the mixer can.
- 6.45 Remove empty containers from the mixer bay and close the door. All personnel then retire to the control cell, closing the mixer bay door on leaving.
- 6.46 Repeat instructions 6.31 to 6.45 for each subsequent addition of ingredients or further mixing time.
- 6.47 Release and vacuum pump and temperature control buttons.
- 6.48 Press the FUNCTION VERIFY and CAN VAC buttons. While you hold BOTH buttons down, the following lights will be ON: Raise, Lower, Run, Vacuum Pump, Deluge Primed. The vacuum ballast tank will vent provided it has no signal to prevent this. When the ballast tank has vented fully, as shown by pressing key 7 on the keyboard, ensure that the CAN V. C button is released.
- 6.49 Close and lock the door of the Control Room. Carry this key with you while working at the mixer. Move to the Mixer Bay. Disconnect the water outlet and inlet flexibles to the mixer can. Uncouple the temperature transducer. Using the earthed spatula supplied, scrape propellant from blades into the mixer can.
- 6.50 Wrap blades with polythene. Remove earthing clip. Place lid on mixer can. Transfer the can to bldg 123, Bay 1.
- 6.51 Turn on fume cupboard and perform all casting operations therein. Fill the specified sample boxes and viscosity specimen container using a spatula provided. The viscosity sample requires immediate transfer to the test facility.
- 6.52 Clean down all equipment. Ensure that the O-Ring in the mixer flange is removed and greased with petroleum jelly, the groove cleaned and the O-Ring replaced. Also ensure that the O-Ring on each ultra-violet detector viewing port seal is lightly greased.

- 6.53 Return to the nitrogen bottle and turn the main valve off. Release the regulator valve until it is free.
- 6.54 Turn off the main water isolation valve to the south of the Plant Room. Turn off the cooling water switch outside the Plant Room on the south side. Turn the red water isolating valve off.
- 6.55 In the Plant Bay, on the Haake Thermocirculator, turn the front Green power switch off, i.e. down, and turn the switch on the top unit to the "O" position, i.e. off. Turn the two power point switches off.
- 6.56 On the centre panel, turn the Rapier motor control key to the off position.
- 6.57 On the left panel, ensure that the deluge system key and the water power bypass key S5 are off.
- 6.58 Turn off the vacuum pump isolator switch.
- 6.59 Turn off all light switches by the door.
- 6.60 Close the doors of both bays and return with both signs to the Control Panel. Release vacuum pump, monitor power and equipment power buttons. Turn off Orange control panel isolating switch at top right of Control Panel. Turn off TV monitor power and wall switch. Turn off and remove system selection and operation keys. Close the bay and turn off the lights.
- 6.61 Return all keys to the O-I-C, PDA2's Office (Bldg 170).
- 7. Mixing Operations (Automatic Control)
 - 7.1 Activate automatic control by turning the control key to auto (position 1). All panel lights will go out.
 - 7.2 Ensure that wall switch and screen switch for TV monitor are on.
 - 7.3 Turn on the wall switches and computer switch to the laser personal computer. Insert the floppy disc to record the mix parameters. The computer will display the message "C\DSTO". Type DSTO and press Enter.

- 7.4 When the computer asks for the "user name" code, type and press the Enter key as directed by the O-I-C, PDA2.
- 7.5 The computer will then ask for a password. Type and press the Enter key as directed by the O-I-C, PDA2. Capital letters MUST be used where directed. If this password is not typed and entered within 60 seconds, the screen returns to 7.3 above.
- 7.6 If there has not been a deluge check in the last 28 days, the screen will display: "Deluge Check in Progress".
- 7.7 As directed by the O-I-C, PDA2, perform the LIVE or SIMULATED test and purge the lines of air as described in 5.13. Return to the Control Panel. If screen is NOT at step 04, "Check if Explosives are on site", press F1.
- 7.8 Press F2. Provided that the fault light on the panel is off, the screen will ask: "Are Explosives on site?" and invite a "Yes" response. If this is the correct response, press Enter. Check the Control Panel to ensure that the Amber light is on. The screen will now ask: "Are Explosives to be Used?" and invite a "Yes" response. If this is the correct response, press Enter.
- 7.9 If No is the correct response to either of the above questions, press N and Enter.
- 7.10 The screen will display: "Load Ingredients Now".
- 7.11 Close and lock the door of the Control Room. Carry this key with you while working at the mixer.
- 7.12 Take the mixer can to the balance and load the first ingredient as shown on the PROPELLANT/EXPLOSIVE PROCESSING SHEET. Return to the Mixer Bay. Place the can in position and the Teflon spacer in position below the mixer. Ensure that the O-ring vacuum sealing gasket is in position around the mixer flange. Remove the mixer can cover.
- 7.13 Using the alligator clip provided, secure the earthing lead from the frame to the body of the mixer can.

- 7.14 Ensure that each container, scoop and spatula is connected by earthing lead and clamp to the mixer frame. Carry out the addition of ingredients as called for on the MIXING PROCEDURE. Record details on the INGREDIENTS/WEIGHINGS CHECK SHEET.
- 7.15 If required, after earthing the spatula provided, scrape down the blades to ensure that all powder ingredients are in the body of the mixer.
- 7.16 Using a clean, dry rag, wipe all spilled ingredients from the top of the mixer can.
- 7.17 Plug in temperature transducer and connect the water outlet and inlet flexibles to the mixer.
- 7.18 Remove empty containers from the building and close the building door. Return to the Control Cell and unlock the door.
- 7.19 On the Control Panel, ensure that the vacuum light is on. On the computer, press F2 to continue.
- 7.20 The screen will display the operating variables. Some of these are changed for each mix or mix cycle, while others remain the same for many mixes.

Mix Serial Number

Condition	Set Point	Minimum	Maximum
Start Blade Speed			
Mix Blade Speed			
Contents' Temperature			
Mix Time w/o Vacuum			
Mix Time with Vacuum			
Contents' Vacuum			
Ballast Vacuum			
Logging Period			

- 7.21 To enter the values shown in the PROPELLANT/EXPLOSIVE PROCESSING SHEET, press F3. In the order shown on the screen, type in the value required INCLUDING the decimal point and press Enter.
If no change to a value is required, accept that value by pressing Enter.
- 7.22 After entering all values, check that they are correctly shown on the screen. If not, continue pressing Enter until you again come opposite a wrongly entered value on the screen. Type in the correct value and press Enter. Repeat as required until all values are correctly shown. Press key F2 to continue.
- 7.23 If you enter a set point value which is outside the maximum and minimum values previously set, the screen will display an "Error Message" and return to the operating variables display. Press F3, enter the correct value, and press F2. If the error message is still displayed, refer to the O-I-C, PDA2.
- 7.24 The screen will display "Clear Processing Area". Call a warning through the intercom: "Stand clear, can going up". Press F2. If the can temperature is outside the pre-set limits, the screen will display "Waiting for Temperature" and the pre-set and actual values. If this is the first mix cycle, press F2 to continue. If this message is displayed at the start of ANY later cycle refer to the O-I-C, PDA2, before pressing F2 to continue.
- 7.25 The screen will display "One Pint Mixer Overview". The blades will start to turn. If explosives are being mixed, check that the Red light is on. At the top left of the screen, the process step in progress will be displayed.

Note: If you wish to stop the mix at any stage, press F1.

During running, the process parameters can be monitored using the keypad. On the top right of the panel, below the value, will be displayed the title of the process parameter being monitored, together with whether the set point value (SP), or the process value (PV), is being displayed.

7.25 (Ctd)

Normally, the process value of a parameter is displayed, and the set point value of that process parameter is obtained by pressing the right hand arrow on the keyboard. The process value is re-displayed by pressing the left hand arrow on the keyboard.

Key Number	Process Parameter
1	Start Speed
2	Mix Speed
3	Contents' Temperature
4	Mix Time without Vacuum
5	Mix Time with Vacuum
6	Contents Vacuum
7	Ballast or Keg Vacuum
8	Mix Speed
9, and Down Arrow Once	Haake Temperature (Thermocirculator)
9, and Down Arrow Twice	Bay Temperature
9, and Down Arrow Thrice	Bay Humidity

- 7.26 When the blades reach the start speed specified, observe on the TV screen that the Mixer Bay is clear and call a warning through the intercom: "Stand clear, can going up".
- 7.27 The mixer can will rise. The blades will then accelerate to the run speed. When this run speed is reached, the computer will start to count down the mixing time without vacuum, displaying the remaining time on the screen.
- 7.28 When the mixing time without vacuum is completed, and mixing with vacuum has been programmed, the vacuum will then be admitted to the mixer can. Check that the can vacuum light on the Control Panel is on. SEE NOTE ON NEXT PAGE.

Note: The value of vacuum in the system is shown on the left gauge on the wall above the Control Panel, and also by pressing key 6 for digital display on the right hand side of the Control Panel.

- 7.29 When the system reaches the maximum value of vacuum permitted, the computer will start to count down the mixing time with vacuum.
- 7.30 When all the time in this mix cycle has elapsed, call a warning through the intercom: "Stand clear, can coming down". The can will then lower automatically. Check that the Red light is off.
- 7.31 The screen will indicate "Cycle Complete". Press F1. If a further cycle is required, press F2. Repeat instructions 7.8 to 7.30 for each further mix cycle. But 7.12 and 7.17 should require no action.
- 7.32 If there is no further mixing, press F1. The screen will display "Clean Up Area".
- 7.33 Close and lock the door of the Control Room. Carry this key with you while working at the mixer.
- 7.34 Disconnect the water outlet and inlet flexibles to the mixer can, and uncouple the temperature transducer.
- 7.35 Using spatulas supplied, scrape propellant from blades into the mixer can.
- 7.36 Wrap blades with polythene, place lid on mixer can and remove earthing clip. Transfer the can to Bldg 123, Bay 1.
- 7.37 Turn on fume cupboard and perform all casting operations therein. Fill the specified sample boxes and viscosity specimen container using a spatula provided. The viscosity sample requires immediate transfer to the test facility.
- 7.38 Clean down all equipment. Ensure that the O-Ring in the mixer flange is removed and greased with petroleum jelly, the groove cleaned and the O-Ring replaced. Also ensure that the O-Ring on each ultra-violet detector viewing port seal is lightly greased.

- 7.39 When clean up is complete, press F1. The screen will display "Remove Floppy Disc. Turn Computer Off". Turn computer body switch and two wall switches off. Turn control key on panel to "Manual".
- 7.40 Press the FUNCTION VERIFY and CAN VAC buttons. While you hold BOTH buttons down, the following lights will be ON: Raise, Lower, Run, Vacuum, Deluge Primed. The vacuum ballast tank will vent provided it has no signal to prevent this. When the ballast tank has vented fully, as shown by pressing key 7 on the keyboard, ensure that the CAN VAC button is released.
- 7.41 Turn off the main water isolation valve to the south of the Plant Room. Turn off the cooling water switch on the south wall outside the Plant Room and the Red water isolating valve.
- 7.42 In the Plant Bay, on the Haake Thermocirculator, turn the front Green power switch off, i.e. down, and turn the Black switch on the top unit to the "O" position, i.e. off. Turn the two power point switches off.
- 7.43 On the centre panel, turn the Rapier motor control key to the off position. On the left panel, ensure that the deluge system key and the water power bypass switch are off.
- 7.44 Turn the vacuum pump isolator switch off. Turn off all light switches by the door.
- 7.45 Close the doors of both bays. Return to the nitrogen bottle and turn the main valve off. Release the regulator valve until it is free. Return with the danger signs to the Control Panel. Release vacuum pump, monitor power and equipment power buttons.

Turn off:

- Orange control panel isolating switch at top right of Control Panel
- TV monitor power and wall switches
- Intercom

Turn off and remove system selection and operation keys. Close the bay and turn off the light. Return all keys to the O-I-C, PDA2's office (Blad 170).

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Commissioning and operating instructions of one pint (US) mixer

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ABSTRACT

A one pint (US) vertical bladed planetary action mixer was installed in Production Development Area No. 2 of MRL Explosives Ordnance Division, Salisbury. This report describes the rationale for purchasing the mixer, along with a description of the equipment installed, together with operating instructions.

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Commissioning and Operating Instructions of One Pint (US) Mixer

P.J. Barry and J. Levers

(MRL-TN-634)

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